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# Nest-site Selection by Belted Kingfishers (Ceryle alcyon) in Colorado

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# Nest-site Selection by Belted Kingfishers (Ceryle alcyon) in Colorado

ABSTRACT.—Along the Cache la Poudre River in northern Colorado, belted kingfishers nested in relatively tall banks that lacked a toe. Kingfishers constructed burrows in soils that contained significantly less sand than was present at systematically sampled points. This finding conflicts with earlier findings that indicate kingfishers select sandy soils for burrow construction. Otherwise, the physical characteristics of banks used by belted kingfishers in Colorado were similar to those found elsewhere.

## INTRODUCTION

Throughout most of North America, belted kingfishers (*Ceryle alcyon*) nest in burrows that they construct in dirt banks. They will, however, also use a wide array of other nesting substrates (Hamas, 1994). The primary factors that have been identified as being important to kingfishers' nest-site choices are availability of prey, slope of banks, soil composition, and height of banks (Brooks and Davis, 1987; Hamas, 1994). Brooks and Davis (1987) concluded that kingfishers selected high, steep banks for nesting to avoid flooding and predation and that soils containing a high percentage of sand might provide better drainage for nests than other soils. It is unknown whether these factors are important throughout the range of kingfishers, because studies of nest-site selection have been restricted to the northeastern part of the species' range. Longitudinal variation in body size and wing dimensions have resulted in recognition of western and eastern subspecies of belted kingfishers (reviewed in Hamas, 1994). There is little evidence to evaluate whether these morphological differences are reflected in important ecological characteristics of this species, such as nest-site selection. We examined nest-site selection by kingfishers in Colorado, which is in the western portion of their range, and compared our results to those reported for eastern populations.

## METHODS

We investigated nest-site selection by kingfishers along a 20-km-long segment of the Cache la Poudre River at Fort Collins, Colorado. We selected 28 banks based on their physical appearance and recorded the number and location of nests constructed in these banks from 1992 to 1995. Of these banks, 20 were used by nesting kingfishers and eight were unused. Over the 4 yr of the study, kingfishers constructed between one and six burrows in each used bank. Of the 20 used banks, 18 had $\leq$ one burrow/year constructed in them. The remaining two used banks had two burrows constructed in them during some years. At banks where >one burrow was constructed during the study, we randomly selected a single burrow to represent that bank in the analysis. Because many banks (18 of 28) had a distinct toe (*i.e.*, part of the bank had sloughed off and created a distinct region of lower bank with a shallow slope), we also categorized banks by the presence/absence of a toe. For banks with a toe we measured only the steep upper portion. When there was vegetation on the toe of the bank, we defined the bottom of a bank as the point where the vegetation ended. When the toe was unvegetated we defined the bottom of the bank as the point where the substrate changed from soil to streambed. We measured the width of the bank as the distance between the points where the slope began to flatten and exposed soil yielded to vegetation on the bank.

At used banks we centered our measurements on the burrow. We measured the height of the burrow and the height, slope and soil composition of the bank (we refer to these measurements hereafter as burrow measurements). Because of the partial collapse of some banks before measurement, some of our analyses contain fewer than 20 used banks. We also measured the height, slope and soil composition at one systematically determined point on both used and unused banks (we refer to these measurement hereafter as systematic measurements). Systematic measurements were taken at the highest point on the bank, where we collected our soil sample at 70% of the maximum height. We selected this location to sample soil because it reflected the typical position of kingfisher burrows in banks.

To assess nest-site selection within used banks, we conducted paired analyses (Wilcoxon's signed-rank) of our burrow and systematic measurements. We also correlated our systematic measurements with the number of nests constructed in used banks. Further, to investigate the relationship between bank characteristics and burrow placement, we measured two aspects of burrow location. First, we

TABLE 1.—Means, standard deviations and sample sizes of measurements made at used and unused nest banks along the Cache la Poudre River in Fort Collins, Colorado

| | Used bank | | Unused bank |
|---|---|---|---|
| Variable | Burrow $\bar{x} \pm$ SD (n) | Systematic $\bar{x} \pm$ SD (n) | Max height $\bar{x} \pm$ SD (n) |
| Bank height (m) | 1.8 ± 1.0 (20) | 1.9 ± 1.0 (18) | 1.8 ± 0.4 (8) |
| Width of bank (m) | 19.8 ± 18.1 (20) | 19.8 ± 18.1 (20) | 9.4 ± 8.4 (8) |
| Slope of bank (°) | 79.9 ± 7.0 (18) | 80.5 ± 8.5 (17) | 80.1 ± 9.0 (8) |
| Sand composition (%) | 32.0 ± 14.2 (18)* | 41.1 ± 16.3 (18)* | 43.0 ± 23.0 (8) |

* Differed significantly $U = 84.5$, $P < 0.01$

measured the vertical distance from the burrow to the top of the bank. Second, we dropped a vertical line from the point where the bank reached its maximum height and then measured the horizontal distance from this line to the burrow. We correlated these variables with bank height and bank width, respectively. To assess selection between banks, we compared our systematic measurements from used and unused banks (Wilcoxon's rank-sum).

The sand, silt and clay composition of the soil samples was analyzed using a Lamotte Soil Texture Unit® (Lamotte Company, Chestertown, Maryland). We then qualitatively compared our soil samples to those of the Larimer County Soil Survey to determine if our findings were consistent with the primary soil types along the Cache la Poudre River.

## RESULTS

There was a positive correlation between the number of nests constructed in a bank and its height ($r_s = 0.72$, $P = 0.001$, $n = 18$). Also, used banks tended to lack a toe (12 of 20) whereas, unused banks tended to have a toe (7 of 8; $\chi^2 = 3.45$, df = 1, $P = 0.06$). Height, width, slope and soil composition of the banks did not differ significantly between used and unused banks (Table 1).

Among used banks, the distance from the burrow to the top of the bank was positively correlated with the maximum height of the bank ($r_s = 0.63$, $P = 0.01$, $n = 17$). The horizontal distance from a burrow to the point where the bank reached its maximum height was significantly correlated with bank width ($r_s = 0.58$, $P = 0.0001$, $n = 16$). These correlations indicate that the area of the bank that is suitable for construction of kingfisher burrows is related to the size of the bank. Soil samples collected at burrows consisted of <50% sand and were comprised of significantly less sand than systematically located points in the same bank (Table 1). The results of our soil tests were consistent with the National Cooperative Soil Survey of the Larimer County (*U.S. Dep. Agric. Soil Conserv. Serv.* and *For. Serv.*, 1982), which indicated that soils in our study area were primarily of clay loams, fine sandy loams, and river wash.

## DISCUSSION

Our results indicated that height of banks and absence of a toe were the most important correlates of bank use by nesting belted kingfishers along the Cache la Poudre River. Unused banks were more likely to have a toe than were used banks. Among used banks, the number of nests constructed in a bank was significantly and positively related to the height of a bank. The relationship between bank height and frequency of use contrasts with the similarity of the physical structure of used and unused banks (Table 1). We argue, however, that the similarity between used and unused banks largely reflects our use of gross physical appearance to select the banks that we monitored. Thus, we did not expect used and unused banks to differ in gross physical appearance even if use was random. That eight of these banks remained unused throughout the study, however, while other banks were used six times indicates the potential importance of other factors in determining bank use. Factors that are likely to be important include site fidelity, subtle physical characteristics of banks such as presence of a toe and ecological factors such as food distribution and location of territory boundaries.

Likely explanations for the importance of the height of banks and the presence of a toe are that

burrows in tall banks are less likely to be flooded because they are above most spates. Further, depredation of a burrow in a tall bank that lacks a toe might also be less likely, if the absence of a toe prevents predators from reaching nests. These interpretations agree with those of previous studies conducted on nest-site selection in this species (Cornwell, 1963; Brooks and Davis, 1987), however, data that test the effect of bank characteristics on nest predation rates are generally lacking.

Brooks and Davis (1987) found that all of their burrows had >75% sand composition, and they implied that the percentage of sand in soils limited the use of banks for nesting. Our soil samples were not consistent with these conclusions. The soils sampled by Brooks and Davis (1987), however, were taken from a fairly narrow range of soil types. It is possible that other factors, such as rainfall, may interact with soil composition to affect nest-site selection by belted kingfishers. Alternatively, given that most of the soils along the Cache la Poudre had <50% sand, belted kingfishers may not have been able to nest in their preferred soil types in this area. Nonetheless, our data indicate that belted kingfishers are more flexible in their nest-site use than suggested by Brooks and Davis (1987). This pattern is, perhaps, not that surprising when considering the variety of substrate use reported elsewhere in the literature (reviewed in Hamas, 1994), and this flexibility may contribute to the extensive breeding distribution of the species. Further, this plasticity in nest-site choice may contribute to our finding that longitudinal variation in morphology of belted kingfishers is not reflected in their nest-site selection.

## LITERATURE CITED

BROOKS, R. P. AND W. J. DAVIS. 1987. Habitat selection by breeding Belted Kingfishers (*Ceryle alcyon*). *Am. Midl. Nat.*, **117**:63–70.

CORNWELL, G. W. 1963. Observations on the breeding biology and behavior of a nesting population of Belted Kingfishers. *Condor*, **65**:426–431.

HAMAS, M. J. 1994. Belted kingfisher (*Ceryle alcyon*). *Birds of North America*, **84**:1–16.

U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE AND FOREST SERVICE. 1982. National Cooperative Soil Survey of the Larimer County Area. 174 p.

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